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Mysteries of Magnaflux Test Are Described

Two Methods of Magnaflux Testing Available, Known as B Max and Residual Methods

By Walter M. Saunders, Jr.

Rhode Island Chapter—At the March 7th meeting Frederick F. McIntosh, director of metallurgy, Crucible Steel Co. of America, introduced about 100 members and guests to some of the mysteries of inspection of quality steels by the magnaflux method. The title of his talk was "Magnetic Testing of Metals".

Before proceeding to a detailed description of the magnaflux tests, Mr. McIntosh illustrated by lantern slides some of the earlier magnetic tests, such as the Sperry and Burroughs methods. The chief disadvantage of all these tests is that they do not tell the nature of a defect too well, and that strains give galvanometer displacements that confuse.

The magnaflux method was based on a test developed and used by Major Hoke at the Bureau of Standards during the last War, when some rapid and non-destructive method of test became imperative.

Two broad magnaflux methods are available, one known as the B max, and the other the residual method. The former is carried out by immersing the steel in kerosene, with iron filings, and passing a current of about 2000 amp. through the piece.

In the residual method, the current is passed, shut off, and the piece immersed. The direction of the current in relation to the piece, and other changes, allow the B max method to be modified in six ways, and the residual in three.

The principle of the magnaflux method appeared quite simple after Mr. McIntosh explained that a discontinuity in steel causes an interruption in the lines of force, along which the filings arrange themselves.

The great difficulty, however, is that (Continued on page 4)

Bain Gives Course to 70% Of Golden Gate Membership

By Clinton L. Dornbush

Dr. E. C. Bain scored again before an average attendance of 70% of the members of the Golden Gate Chapter. His lecture course on the function of alloying elements was very interesting and educational.

Dr. Bain's ability to reduce pertinent facts to their simplest terms made everyone feel that functions of alloying elements were very easy to understand. His excellent explanation of equilibrium diagrams will make them of more practical value to those who attended.

The lectures were held in the Engineering Building of the University of California and were open to members only, except for a group of advanced metallurgical students from the University. This group was invited under the educational program of the Chapter which strives to bring forward the functions of the Society.

National Officers Welcomed in Texas



"You-all Is Welcome to Texas. The State am Yours," Says Texas Chapter Chairman Don Garrison to A.S.M. President Gill When the Latter Arrived with Secretary Eisenman to Help Celebrate National Officers Night on March 21. At right, Cinema-Addict Gill discusses with Vice-Chairman Wade Hampton the proper openings for the admission of light.



At Left, Charles F. (Spark Plug) Lewis Relaxes After Arranging Dinner for 200 Members. Also snapped at the meeting are, left to right, W. L. Childs, president, Reed Roller Bit Co.; Bob Schlumpf, metallurgist, Hughes Tool Co.; and C. H. Shapiro, metallurgist, Reed Roller Bit Co., also chairman of the National Constitution and By-Laws Committee.

New York Course on Corrosion Attracts Over 200 to Each Lecture in Series of Five

By Harold M. Malm

From 200 to 240 interested people attended each lecture of the excellent educational series sponsored by the New York Chapter on "Corrosion".

The course consisted of five lectures presented on consecutive Tuesday evenings starting Jan. 9 and ending Feb. 6, as follows:

1. The Nature and Significance of Corrosion, by Robt. J. McKay of the International Nickel Co.
2. The Nature of Corrosion, by F.

L. LaQue, also of International Nickel Co. (Spectacular demonstrations of the principles set forth in the preceding lecture)

3. Principles and Practice of Corrosion Testing, by L. W. Hopkins of American Chain and Cable Corp.

4. Influence of Composition and Treatment with particular reference to Iron and Steel, by C. P. Larrabee of Carnegie-Illinois Steel Corp. Corrosion Laboratory.

5. The Prevention of Corrosion, by R. M. Burns of the Bell Telephone Laboratories, New York.

The vast interest in corrosion attracted this series to groups from chemical fields, mechanical engineers, metallurgists, students from several universities and men from various other walks of life.

Every lecture was a "sell-out" indicating that the topic is one of enormous importance. The Educational Committee, made up of John B. Austin of the U. S. Steel Corp. and G. L. Craig, metallurgist for Consolidated Calumet and Hecla Copper Co., is to be congratulated on the selection of the topic and the excellent group of speakers they succeeded in obtaining to deliver the lectures.

Closing Date for Papers

All members of the Society are cordially invited to submit technical papers to the Publication Committee for its consideration for presentation before the National Metal Congress in Cleveland next fall.

Papers should be sent to the National Office in Cleveland to the attention of Ray T. Bayless, assistant secretary, American Society for Metals, not later than June 20, 1940. Prior notification of your intention to submit a paper is desirable.

Big Demand for Exhibit Space In Metal Show

Additional Floor Space in Cleveland's Public Auditorium Must Be Laid Out

The 1940 National Metal Congress and Exposition scheduled for the Public Auditorium in Cleveland, the week of Oct. 21, has already exceeded in space reservations the entire floor space occupied at the Metal Exposition held in Chicago last year.

This is most unusual inasmuch as it represents the largest advance space reservation in the history of the 22 expositions sponsored by the American Society for Metals.

On Feb. 19 a floor plan and reservation blank were forwarded to all previous exhibitors and they were requested to indicate to headquarters their choices of location. They were informed that spaces would be assigned by the committee as soon as possible after April 6.

Reservations began to arrive immediately, and on the closing date requests had been received for over 86,000 sq.ft. of space. This amount is in excess of the total amount sold at the Chicago Show last year, and a greater amount of space than was provided for in the layout of the Cleveland Auditorium.

Consequently, it is impossible for the committee to assign space at this time, since it will be necessary to lay out additional exhibit space in the Auditorium and then permit all previous exhibitors to make new selections (if they so desire), including the newly laid out space.

There will be plenty of show space available in the Public Auditorium—up to 150,000 sq.ft.—but the amount of space laid out was in accordance with the size of previous expositions.

It is interesting to surmise the reasons for such an enthusiastic response. First, perhaps, might be the increased confidence of business in the future industrial outlook, and second might be the continued recognition of the National Metal Exposition as the most outstanding metal merchandising activity of the year.

Compliments

To F. T. Llewellyn, who recently retired after almost 50 years with American Bridge Co. and Carnegie Steel Co., on being awarded a certificate of honorary membership in the American Welding Society.

To General Alloys Co. and its president, Harry Harris, on the completion of a job that other experts pronounced "impossible"—namely, the casting of a ten-ton stainless steel plaque mounted on the facade of the new Associated Press Bldg. in Rockefeller Center—the first heroic sculpture cast in stainless steel, the largest metal bas-relief in the world, and the largest stainless steel castings ever poured.

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RAY T. BAYLESS.....Editor
M. R. HYSLOP.....Managing Editor

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Strauss Makes First Announcement of Grinal Treatment

By F. H. Craven

Notre Dame Chapter—Fostering cooperation with other technical organizations in our territory, the February program was a joint meeting with the Michiana Chapter of the American Foundrymen's Association.

The speaker of the evening, Jerome Strauss, vice-president of the Vanadium Corp. of America, began his talk by discussing the basic nature of vanadium upon which its uses in ferrous metallurgy are founded.

Mr. Strauss discussed thoroughly the action and effects of vanadium upon steel, especially as to heat treatment, and its action on cast iron, particularly its effect upon graphitic structure.

Treatment Increases Hardenability

The real news of the evening, however, came when Mr. Strauss made his first public announcement of the Grinal treatment for steels. This treatment, Mr. Strauss explained, was discovered during the course of extensive studies on the use of very small amounts of vanadium when added to steels, and consists in one of its forms in the addition of very small quantities of a ferro-alloy of vanadium, titanium, and aluminum.

The Grinal treatment has been remarkably effective in increasing the hardenability of plain carbon and low alloy steels, causing them to respond to heat treatment in the manner of highly alloyed steels.

Mr. Strauss cited an example of a heat of 1040 steel, half of which was treated with Grinal.

Samples of this heat when given identical heat treatment had a yield point of 90,000 psi. and tensile strength of 122,000 psi. for the untreated portion of the heat, while the Grinal-treated samples showed the phenomenal values of 226,000 psi. and 263,000 psi. respectively. Low alloy steels revealed comparable results.

As yet, steels treated by this process have not been used commercially but the major steel companies have been experimenting with the treatments for the past two years.

Should results continue to substantiate present findings, it is safe to say that the Grinal treatments will become one of our most important steel making processes.

Cornell University Uses Metals Handbook As Text Throughout Engineering Courses

One of the many schools and colleges using the A.S.M. Metals Handbook as a text is Cornell University. Here all engineering students are required to use the Handbook in their sophomore, junior and senior years.

In response to a request from the National Office, J. O. Jeffrey, professor in the College of Engineering, has outlined the uses of the book in these courses.

"We have long been conscious of the fact that a thorough knowledge of materials is of utmost importance to every engineer," said Dr. Jeffrey, "regardless of whether he is primarily concerned with design, operation, sales or administration. With this thought in mind, the instruction in materials, for every engineering student at Cornell, begins in his freshman year and continues through his four years.

"All engineering students begin their study of materials with fundamental courses in physics and chemistry, together with Introductory Engineering Laboratory Courses.

"In addition, all sophomore engineering students are required to take a lecture course on the 'Materials of Engineering'. It was for this course and subsequent courses in metallurgy that we selected the Metals Handbook as a text, and its use is working out very nicely in conjunction with the lecture, classroom and laboratory work.

Scope of Sophomore Course

"To quote the Engineering College announcement, the first term of the sophomore Materials Course is 'an elementary lecture course in metallurgy, covering the process metallurgy of iron and steel . . . mechanical working operations, and cast irons. Particular emphasis is placed on the constitution and structure of metals and alloys . . . Heat treatment operations are studied with reference to their effects on the constitution and the mechanical properties of alloys. An introduction is given to methods of testing . . .'

"Suitable references in the Handbook are selected for study to parallel the lecture material.

"In the second semester, the first portion of the course covers the alloy steels, cemented carbides, non-ferrous metals and alloys, and corrosion. The

Winston Exhibits Alloys Of Magnesium at New York

By J. Z. Briggs

New York Chapter—A. W. Winston, chief metallurgist of the Dow Chemical Co., presented the technical speech at the March 11th meeting on the present trend in magnesium alloys. Details of his talk were presented in the March issue.

Mr. Winston had brought with him a large number of examples of recent applications of magnesium and its alloys. The members of the Chapter enjoyed looking over these articles (and incidentally, the feeling of power at being able to lift a large piece with no undue exertion).

A. B. Kinzel, chief metallurgist of the Union Carbide and Carbon Research Laboratories, and one of the Chapter's authorities on all types of metallurgy, was technical chairman.

The trials and tribulations of science editors of newspapers who must be prepared to cover adequately any scientific topic from genetics to geophysics and medicine to martensite were entertainingly discussed by Waldemar Kaempffert, science editor of the *New York Times*, in the coffee talk which followed the dinner.

Handbook is used here to supplement the lecture work.

"The last portion of the course deals with the non-metallic materials—refractories, fuels, wood, plastics, cementing materials and concrete.

"In the junior year, all engineering students are given a course in 'Materials Testing and Physical Metallurgy'. It is here perhaps that the student finds the greatest use for his Metals Handbook. This is a laboratory course, and each weekly laboratory experiment requires a complete report covering the theoretical background, the apparatus and equipment used, the test data and results, including their practical application and significance.

Use in Selecting Materials

Finally, regardless of the course (Mechanical, Electrical, Chemical Engineering, etc.) or option (Aeronautical, Metallurgical, Automotive, Industrial, etc.), selected by the student for particular study during his last two years, it is necessary for him to be familiar with and to design equipment pertaining to his chosen field of study. "Here he will find his Metals Handbook a most valuable adjunct to his work, for with it he can make a most judicious selection among the many materials which might be available for the particular problems which he encounters.

"I trust that this will give a fairly comprehensive idea of how our courses in materials are handled and their relationship to the student's training in engineering at Cornell. In this integrated course of study, the Metals Handbook performs a most desirable service."

University Is Host to Cincinnati Chapter

By K. Siems

Cincinnati Chapter—A most interesting and certainly most successful meeting was held on March 14 at the University of Cincinnati. A splendid dinner served in the Faculty Dining Room started activities and an inspection trip through the metallurgical division of the Chemical Engineering Department of the University was arranged for as the second half of the meeting.

The speaker of the evening was George M. Enos, associate professor of metallurgy, University of Cincinnati, and at present Captain, Special Reserve, acting as chief inspector of the Cincinnati Ordnance District. He delivered a talk on "Visual Examination of Steel."

This was a repetition in part of a lecture course he conducted at the National Metal Congress in Chicago in 1939. It will not be reported on herein as it will be available in its entirety in book form at a later date.

Following Dr. Enos, David Diltz, a graduate student in metallurgy of the University of Cincinnati, presented as his subject: "Determination of Austenitic Grain Size By Heat Etching".

He devoted his brief talk principally to the details and functioning of the instrument used to purify the oxygen from the time it leaves the cylinder and before its entry into the furnace. This apparatus was later seen in actual use as part of the inspection trip mentioned.

Details of the program were arranged by John F. Kahles, instructor, metallurgical department, University of Cincinnati, and a member of the Cincinnati Chapter.

Misinterpretation Corrected!

Allan Bates, of the Westinghouse Electric & Mfg. Co., calls our attention to the rather over-enthusiastic review of his recent talk on plastics before the Rock River Valley Engineering Council and Rockford Chapter A. S. M.

According to the account of this talk published in the March issue of THE REVIEW, Dr. Bates stated that practically an entire automobile could be built of plastics. Bates says that he himself would not care to ride in such an *Ersatz* vehicle, even if it were literally possible to build one.

The report of the talk also made points concerning the cheapness of the plastics and the use of waste cellulosic material such as cornstalks which were not in line with the statements actually made by the speaker.

Editor Tells Notre Dame What Makes Quenched Steel Soft

By Francis T. McGuire

Notre Dame Chapter—Speaking upon the intriguing subject, "What Makes Quenched Steel So Soft?" the editor of METAL PROGRESS, Ernest E. Thum, mixed the ingredients of philosophy, science, and subtle humor into a heady cocktail which stimulated the members and held their interest throughout the discussion.

Mr. Thum was the speaker for the March meeting of the Chapter, held on the 13th of the month.

The speaker did not elucidate the causes of the heat treater's quenching failures upon the basis of incomplete carbide solution, retained austenite, or any one of the intermediate austenite decomposition products. Rather, he assumed that the metallurgist obtains a properly heat treated specimen of high tensile strength, but he showed that this specimen is comparatively weak when considered in terms of the calculated obtainable strength.

It was stated that the mathematical physicist finds, from calculations of the force necessary to separate the atoms, that in practice we fall far short of the strength possibilities of metals. This discrepancy is attributed partly to the mosaic structure of crystalline grains.

The assumed homogeneous single crystal is, in probability, many small perfect crystals, each with an orientation slightly different from that of its neighbors. The total deviation is very small but the boundaries of the blocks may be considered as submicroscopic voids, which cause stress risers and lower measured strength.

The meeting was well attended and the lecture was so well enjoyed that it evoked an expression of a desire that the address be published, in METAL PROGRESS or elsewhere, and made available to others.

Welding Contest Announced

Sponsored by the Resistance Welder Manufacturers Association and the American Welding Society, a contest has been announced for technical papers on resistance welding subjects.

The contest is open to anyone in the United States and Canada and to any member of the American Welding Society. The seven prizes consist of one of \$300, one of \$200, one of \$100, and four \$25 prizes.

Further information may be had from the Resistance Welder Manufacturers Association, 505 Arch St., Philadelphia, or the American Welding Society, 33 West 39th St., New York City.

Heat Treating Hi Speed Tools Is Still an Art

Frazer Discusses Practical Factors and Scientific Advances at Past Chairmen's Night

By Fred P. Peters

New Jersey Chapter—Still young enough to be able to assemble all its past chairmen on one platform, New Jersey Chapter celebrated its "Past Chairmen's Night" at Newark's Essex House on March 18 by presenting each of its ten ex-es with a handsome certificate of gratitude and appreciation.

The men so honored were: W. R. Bennett, H. D. McKinney, J. F. Wyzailek, A. M. McWilliams, W. R. Frazer, W. H. Hall, F. A. Elshoff, J. B. Mudge, C. S. Cronkright, and G. M. Rollason.

Appropriately enough, the evening's lecturer was one of their number—Dr. W. R. Frazer, chief metallurgist of the Union Twist Drill Co., who discussed practical factors and recent scientific advances in "The Heat Treatment of High Speed Steel Tools".

For all our imposing body of scientific knowledge on steel and its heat treatment, Dr. Frazer said, the treatment of high speed tools is still an art, and will probably be so for a number of years, at least until science has lined up all the variables and made them susceptible of control by the hardener.

The fundamental purpose of heat treatment of such tools is the development of the maximum cutting ability in such a way that distortion will be held to a minimum and results will be reproducible.

The chief factors that must be known or controlled are the analysis of the steel, the time of heat treatment, the temperature actually reached by the steel, and the heat treating atmosphere.

High CO Prevents Overheating

Analysis and atmosphere both affect the hardenability of high speed steel. An atmosphere high in carbon monoxide retards the heating-up rate and may even prevent the steel from reaching as high a temperature as it would in a low carbon monoxide atmosphere with conditions otherwise identical. It is typical of the complexity of the art that while a high carbon monoxide atmosphere thus tends to prevent overheating it may also result in excessively carburized surfaces.

Careful preheating, particularly of massive tools, was strongly recommended to minimize distortion during hardening. The mass of the tool may also require such a long time for reaching high heat that it may be advisable to raise the furnace temperature from 2350 to 2400° F. to speed up the heating rate of the tool, although the latter itself may not be allowed to become hotter than 2350° F.

Discussion was unusually lively. Ex-Chairman Bennett agreed that heating tools uniformly would certainly be ideal practice, but finds its attainment still far in the future since we're still unable even to boil an egg uniformly.

New Evidence on Decarb

Sam Tour offered one extremely important point on which he is now accumulating evidence—that the soft skin on some hardened high speed tools that is categorically attributed to "decarburization" is not decarb at all, but almost the reverse.

In the molybdenum-tungsten high speed steels, for example, the high hardening heat causes the austenite to dissolve more carbide, and this carbon-rich austenite transforms so much more

Figure in Broadcast on Man and Metals



Hans Ernst (Left) Was the Narrator for a Broadcast on "Man and Metals" Over Cincinnati Station WKRC on March 29. Next to Mr. Ernst are Kurt Siems, chairman of the Publicity Committee, Cincinnati Chapter, Clay Rambeau, assistant manager of Hotel Alms, and Merle Bernard, the announcer.

Society Uses Radio In Publicizing Metals

In the current campaign by the American Society for Metals to publicize the metallurgical field, and familiarize the layman with the role of metals in everyday life, radio is playing an important part.

National Secretary W. H. Eisenman presented a 15-min. broadcast over Cleveland Station WGAR last January entitled "Man and Metals".

Under this same title Hans Ernst, director of research, The Cincinnati Milling Machine Co., presented a talk on March 29 over Station WKRC in Cincinnati.

Kurt Siems of the Cincinnati Chapter reports a very cordial and enthusiastic reception to this broadcast, with many favorable comments from members and other listeners. The text of the dialogue was adapted to the Cincinnati industrial area, with specific figures and incidental data obtained from the Cincinnati Chamber of Commerce.

Gordon T. Williams, metallurgist, Deere & Co., Moline, Ill., presented a similar radio talk over Station WHBF in the Tri-City region on April 20.

On April 4 Mr. Eisenman again spoke for 15 min. over Station WHK in Cleveland, describing 25 years of progress in metals.

sluggishly on subsequent tempering that there is enough of it retained to give a softer steel.

Who knows? Maybe some day we'll be able to harden high speed tools with predictable results in a few simple stages, none of which will include the currently necessary recourse to the Almighty for supreme guidance.

Fatigue Subject of Joint Meeting

By Monte E. Parker

Puget Sound Chapter of the A.S.M. met in a joint session with the Puget Sound Chapter of the American Society of Mechanical Engineers on March 6 to hear George Huck of the Bethlehem Steel Co. present a paper on "Fatigue in Steel".

Following the paper a lively discussion ensued with contributions from many of the members.

This was the largest meeting held so far this year with over 100 present.

Mehl Speaks At Philadelphia Sauveur Night

Decomposition of Austenite Is Appropriate Subject

By Joseph Missimer

Philadelphia Chapter—The seventh "Sauveur Lecture" of the Chapter was presented on Feb. 23 by Robert F. Mehl, Carnegie Institute of Technology—its subject, "The Decomposition of Austenite".

The S-Curve shows us: (a) The beginning and ending of isothermal reaction, 0.5% and 99.5%; (b) pearlite to the knee—increasing rate of formation on lowering temperature; (c) bainite below the knee to the recess—decreasing rate on lowering temperature; (d) martensite below.

It can be said that the thing to examine in studying hardenability is not the hard constituent martensite, but rather pearlite, for the extent to which martensite forms is determined by the rapidity with which pearlite forms. If pearlite forms slowly, it can readily be avoided in quenching, but if it forms quickly, even rapid quenching will not prevent it, and accordingly martensite will not be formed.

Pearlite Nucleation Discussed

Pearlite forms by nucleation and growth. Studies have shown that faster rate of reaction (and consequently shallower hardening) is promoted by smaller grain size, higher rates of nucleation and growth.

Discussing the theory of nucleation, Dr. Mehl indicated that nodules of pearlite seem to form preferentially at the grain boundaries, although they may form inside the austenitic grain in the presence of inclusions. We find many nuclei at the knee, and very few at high temperatures; the increasing rate of nucleation with decreasing temperature accounts in part for the increasing rate of formation of pearlite on decreasing temperature.

The formation of pearlite is a segregation process, with ferrite and cementite segregating from homogeneous austenite. Austenite remains unchanged up to the pearlite interface.

Pearlite grows edgewise—at least at the knee. Now the growth of pearlite, a process of segregation, requires migration (diffusion) of carbon. It is well known that the rate of diffusion of carbon decreases rapidly as the temperature decreases. Therefore, the rate of growth of pearlite should decrease, but studies have shown that actually it rapidly increases.

Martensite Forms Instantaneously

The answer to this paradox lies in the pearlite spacing. The distance that carbon must diffuse is proportional to the interlamellar distance or spacing. This interlamellar distance keeps decreasing more and more rapidly as the temperature falls, and since carbon has shorter distance to diffuse pearlite grows faster at lower temperature.

Martensite differs fundamentally from pearlite in that it forms instantaneously, not by nucleation and growth, but each needle appears full formed in 0.002 sec.

Between martensite and pearlite, acicular structures now designated as bainite occur. Little is known of the nature of this constituent, or the reason why it forms at an ever decreasing rate with lowering temperature, or whether or not it forms by nucleation and growth.

Dr. Mehl's closing remarks were in memory of the personality and work of Professor Sauveur.

Two Factors in Manufacture of Quality Tools

Rigid Inspection of Raw Material and Control of Heat Treating Are Important

By J. V. Baxter

Boston Chapter—After a most interesting plant visit to the Boston Gear Works, Inc., of North Quincy, Mass., H. H. Kerr, president, related the 50-year history of this important manufacturer of power transmission products.

The technical speaker was Dr. W. R. Frazer, chief metallurgist, Union Twist Drill Co., who spoke on "Metallurgical Control in Tool Manufacture".

Dr. Frazer's experience has been that a very rigid inspection of raw materials and close control over the heat treating operations are two extremely important control points in manufacturing good quality tools.

Inspection of Raw Material

To insure starting with only good quality steel, Dr. Frazer has set up a rigid inspection procedure. The material, depending on the size of bar, must respond to heat treatment, and produce the correct microstructure with good carbide distribution.

The smaller sizes are inspected on a percentage basis. After heat treatment and micro-examination, hardness and decarburization are tested with a file. Small cracks in the wire sizes can be detected by examining sheared ends with a magnifying glass.

Over 2 in. diameter, a disk from both ends of every bar is tested and given 100% micro-examination for carbide segregation. The degree of carbide segregation is in relation to the size of the original ingot and depends upon the amount of working the ingot receives during its reduction to the finished bar size. Sufficient cropping must be made on the ingot to insure soundness. Different sized bars will, therefore, have different degrees of carbide distribution, streaks and laminations.

Dr. Frazer showed interesting examples of carbide streaks and laminations, structures showing heavy banding of carbides, and good normal structure for different sized bars, and the different carbide formations of the "hooky" and cellular types in the larger bars.

Heat Treatment

Dr. Frazer then discussed various heat treating methods but remarked that they might not work in all plants, since hardening room equipment would affect the procedure.

Not enough attention has been given to the preheating of high speed steel tools. Intricate tools should never be put into a high temperature preheat furnace because of sudden expansion introducing strains in the steel. Double preheating is advantageous to eliminate this condition.

Sufficient attention should be given to the support of the tool in the furnace, since it is not as strong at heat as at room temperature.

Dr. Frazer showed practical examples of defects in tools.

Cracks causing tool rejection can often be traced to faulty grinding, as was clearly shown by examination of a broken tooth in a gear cutter.

Micro-examination of a properly and improperly ground tooth, the first file hard, the second soft to the file, showed that the temper had been drawn by the heat generated at the time of grinding; the structure indicated that a temperature of 1400° F. had been reached.

Dayton Hails Bain Course for Providing Factual Foundation

By Fred M. Reiter

The selection of "The Alloying Elements in Steel", as presented by Edgar C. Bain at the Chicago Convention, and subsequently published in book form by the A.S.M., as the course of study this year by the Dayton Chapter, was indeed a wise one.

The course was absorbing and fundamental to the core, so that knowledge of its contents provides a foundation upon which steel problems can be attacked with a factual understanding not hitherto available.

It was planned to have two men lecture at each session on the assigned chapter, so as not to overburden any single speaker. In this way desultoriness was avoided and a different slant procured.

The course was piloted by Stanley R. Prance, of Inland Division, General Motors Corp., Dayton, as chairman, with seven expert instructors.

The very excellent slides illustrated the course in fine profusion and with perfect cohesion with the subject matter. The Society is to be congratulated in their procurement.

In the midst of the course Dr. Marcus Grossmann delivered a superb talk on "Hardenability" that tied right into the subject matter.

The course was started on Jan. 31 and concluded on March 6. Almost 50% of the Chapter's membership signed up and attended the lectures. Over 80% of the class purchased Dr. Bain's book.

Vinylite Resins Are Plastics Group With Wide Field of Uses

By Edward P. Epler

Columbus Chapter—Of the plastics classified as synthetic and thermoplastic, vinyl resins are one of the newest commercially, and certainly one of the most interesting, said George C. Miller of Union Carbide and Carbon Corp., at the Feb. 20th meeting.

Vinyl resins are produced from the simple raw materials—namely, salt, water, coal and air. This, however, is misleading since the manufacturing process is extremely complicated. Mr. Miller described a few of the various vinyls and their uses. Polyvinyl-butyl has been developed as a filler for safety glass having remarkable impact properties through a wide temperature range.

Modified poly vinyl acetate has been successfully used in bonding metal to metal.

The most versatile of plastics is copolymer-vinylite which is made from a mixture of mono-vinyl-acetate and mono-vinyl-chloride.

This interesting resin is used in making lacquers for protective coating on the interior of metal containers, records for transcription of sounds such as used in broadcasting, belts, extruded tubing, wire coatings and a great variety of shapes.

"Vinylite" is extruded through spinners to form "Vynon" yarn, which is woven into chemical filter cloths unaffected by strong acids and caustics.

Vinyl resins have found uses in the manufacture of telephones, airplanes, and automobile accessories.

M. L. S. Marsh of Inland Steel Co. gave a coffee talk and showed some color movies of steel making which he had personally taken. These pictures were very instructive.

Quality of Coat Dependent on Metal Surface

Burns Tells Precautions in Fabrication and Discusses Various Protective Coatings

By J. W. McBean

Ontario Chapter—"Recent Developments in Protective Metallic Coatings" was the subject of a talk at the March meeting by Dr. R. M. Burns, of the Bell Telephone Laboratories.

It was pointed out that the character of the coating can be no better than the surface to which it is applied.

The steel stock for high quality finishes is now prepared with great care to prevent scratching. Stock is annealed in dry non-oxidizing atmospheres; scale is removed by an inhibited sulphuric acid pickle followed by spray rinse and lime neutralization.

Steel strip stock is paper-coated wherever possible during fabrication. Liquid and vapor solvent degreasing using trichlorethylene is in widespread use on an automatic basis.

Not strictly a surface preparation method since it has to do more with final finish, is what is known as electrolytic polishing. This process, which has recently become popular, was proposed 15 years ago by the speaker, using phosphoric acid as electrolyte.

Zinc is probably the most important metal employed for protective coatings, 45% of the domestic production being used in this way. It is applied by hot galvanizing, electroplating, sherardizing and metal spraying.

The biggest development in zinc coating is in electroplating, where, by means of the Tainton process employing purified extract of ore concentrates, zinc is deposited at very high rates of speed, thereby yielding heavy coatings economically.

There have been two important developments in nickel plating: (a) Bright deposits, and (b) heavy coatings rapidly deposited.

A new finish of considerable promise,

Gill Visits Rochester



Chairman E. W. Moore (Right) Welcomes National President James P. Gill to the Rochester Chapter on Feb. 29

President Inspects Plants Before Addressing Chapter

By Randall J. Salzer

Rochester Chapter—National President James P. Gill visited the Chapter on Thursday, Feb. 29, to meet the officers and members.

At noon, the executive group, with Mr. Gill as host, had luncheon at the Sagamore Hotel. Various activities of the Society were discussed informally.

Following the luncheon Mr. Gill and several associates visited the Gleason Works, and also the new Camera Works building of the Eastman Kodak Co. At the University of Rochester 200 members greeted the President.

One of the largest and most enthusiastic audiences of the year greeted Mr. Gill for his main address in the evening on "Recent Development in Tool Steels", an interesting subject, particularly in Rochester.

known as Corronite, has been developed by the Standard Steel Spring Co. It consists of the deposit of nickel followed by a layer of either zinc or tin, the duplex coating being then heated to a temperature of 700 to 1000° F.

Symposium for 1940 Metal Congress Takes Shape; Additional Papers Invited

The response to the invitation of the Publication Committee for papers dealing with the "Surface Treatment of Metals", for the Symposium at the National Metal Congress next fall, has been gratifying.

However, there are undoubtedly others who are engaged in work on this particular subject or are in possession of data pertaining to it who would like to take part in the Symposium.

Papers are in process of preparation on the following topics:

Passivation and Coloring of Stainless Steels.

Tarnishing of Stainless Steels on Heating in Vacuo.

Pretreatment of Structural Steel Surfaces for Painting.

Tin Plate.

Coating Metals in Vapor Phase.

Electrolytic Polishing.

Anodizing Aluminum.

Sodium Cyanide for Surface Carburation.

Activity of Carburizing Compounds.

Chemical Treatment of Magnesium Alloys.

Diffusion Processes for Coating of Metals.

Surface and Subsurface Structure of Mechanically Finished Metals.

Pit Corrosion of 18-8 Stainless Steels.

Papers for this Symposium should be submitted for the consideration of the

Publication Committee by June 20, 1940. Prior notification of the content of your paper is desirable.

Communications should be addressed to Ray T. Bayless, secretary of the Committee and assistant secretary of the American Society for Metals, 7301 Euclid Ave., Cleveland.

Mysteries of Magnaflux Test Method Described

(Continued from page 1)

many conditions such as banding and stress areas act like discontinuities caused by inclusions, but in experienced hands interpretation of the pattern is not difficult. According to Mr. McIntosh, careful manipulators can distinguish inclusions, grinding defects, laps and seams, forging defects, pipes, and blowholes, as distinct from banding and localized stress areas.

Mr. McIntosh included in his talk an excellent movie in color of the crucible process for tool steels.

Captain E. M. Dixon, Rhode Island National Guard, was the coffee speaker at the dinner preceding the meeting. His description of the training given an aviation unit was extremely interesting, and his reminiscences of flying highly entertaining.

Electrolytic Mn Is Now Made Commercially

Pure Manganese, Now Expensive, May Some Day Reach Price of Zn or Cu, Says Dean

By Walter D. Patton

Detroit Chapter—Although electrolytic (pure) manganese is not, at the present time, available at a sufficiently low price to make it attractive to iron and steel producers, it is today being made in commercial quantities, Dr. R. S. Dean of the United States Bureau of Mines told the Chapter at the Fort Shelby Hotel on March 11.

Based on the history of zinc and other elements now produced electrically, the speaker continued, there is good reason to believe the cost of pure manganese may some day reach the present price range of zinc or copper. A cost as low as 5¢ per lb. is not entirely unlikely.

In that event many properties of non-ferrous combinations investigated by the speaker and other metallurgists should become commercially practical, especially certain manganese-copper, manganese-nickel and a series of copper-manganese-nickel ternary alloys.

Electrolytic Mn Is 99.9% Pure

Pure manganese was first produced by distillation in 1924. While the electrolytic manganese is 99.9% pure, according to Dr. Dean, the thermally produced manganese used in iron and steel may contain from 4 to 6% impurities, partly present as oxides that surround the grain boundaries.

These impurities may account in part for the brittleness of manganese in its most widely known form although it should be observed that only one allotropic form of manganese (gamma) is ductile.

Like iron, manganese has several allotrophic forms. (At least three are definitely known to exist, and some observers claim to have identified a fourth.)

In its pure gamma form, manganese is more ductile than copper; it may have a tensile strength of 55,000 psi. which can be increased to 120,000 psi. by cold working. After heat treatment, the hardness may reach Rockwell B-64.

The modulus of elasticity of pure manganese is 23,000,000 psi. compared with only 14,000,000 for copper and 30,000,000 for steel.

Damping Capacity Is High

One of the most useful properties of manganese alloys, the speaker observed, is its outstanding damping capacity at low stresses. Whereas steel may be rated as 0.1% and lead as 2%, manganese alloys have been produced with damping properties rated as high as 5 to 10%.

Dr. Dean then discussed in detail several of the binary and ternary alloys of manganese. Certain Mn-Cu alloys, he pointed out, have excellent electrical resistance and can be drawn into fine wire.

One ternary alloy combination exhibits a hardening range of Rockwell C-30 to C-55. This alloy might be used as a die material on which an impression could be made in the soft condition and the piece hardened by quenching. To improve the toughness, the die could then be flame-softened on the back.

The coffee talk was given by Dr. H. A. Waite of the Michigan Narcotic League, who told of his work in connection with the rehabilitation of drug and dope addicts.

A.S.M. Exhibits at Cleveland Air Show



The American Society for Metals shows the metallurgist's role in aeronautical advancement at the "Wings Over Cleveland" show at the May Co. which drew 150,000 to see the 60 exhibits on display. Chester W. Ruth, advertising director of Republic Steel Corp., inspects the portion of the exhibit depicting early methods of manufacturing iron and steel.

Dr. Jeffries Tells of New Frontiers Open Today in Field of Science and Metals

By Warren A. Silliman

Cleveland Chapter—Forty-three sustaining members were presented with white carnations and honored with a dinner at the Cleveland Club on March 4, set aside as Sustaining Members Night.

The attendance swelled from 175 to around 450 to hear Dr. Zay Jeffries, technical director of the Lamp Department of the General Electric Co. at Nela Park, give a very interesting and inspiring talk on "Metals and Metallurgy in Rapid Evolution".

Dr. Jeffries stated that there are more new frontiers open today in the field of science and metals than at any other time in our history. Many of these new frontiers are to be found in the further development of the technique of combining and adapting such elements as magnesium, beryllium, phosphorus, molybdenum and many others, to bring about new properties and uses.

New developments which are vital in the opening of new frontiers are dependent upon social and economic life. Lack of confidence in the wages of capital tends to retard these developments, but new social benefits will be derived when capital goes back to work.

If any article is good and has economic value, it will soon find a place for itself. The consumer, not the producer, however, is the best judge of such values.

The advent of new material does not mean that old methods and processes will be displaced. For instance, high speed and cemented carbide tools have not displaced carbon steel tools, but have expanded the metal working in-

dustry along new frontiers. Another field which holds a promising future is powder metallurgy. Alnico is a product of this field; as little as $\frac{1}{4}$ oz. of this material built into an armature magnet will withstand a pull of more than 40 lb.

Induction Hardening Is New Tool

The most outstanding present-day revolution in heat treatment of steel is induction hardening. It lends itself to accurate control and flexibility, and with wider use the electrical equipment will become less expensive and less complicated.

Factors which will determine the extent to which induction hardening will be used are: The development of mechanical methods of loading and unloading machines, mass action of engineers in adapting designs to harmonize with this new tool in industry, and making and adapting new steels to this method of treatment.

For a new process or product to gain a footing in our social and economic set-up, it must not only be equal to, but surpass present methods—induction hardening meets this requirement.

Only the future will reveal the benefits to be gained from such recent developments as the breakdown of elements by neutron bombardment or from the extremely high pressures of 3,500,000 psi. developed in the physics laboratory of Harvard University.

Competition Announced for Papers on Manganese

In a competition sponsored by Electro Manganese Corp., three prizes of \$150 each will be awarded for research papers presenting original fundamental research work on electro manganese (99.9% Mn) and its alloys or compounds. Such work may be in the fields of metallurgy, metallography, or chemistry.

Any winning author must have been enrolled as a registered undergraduate or graduate student during the time of the experimental work.

All papers must be submitted in duplicate by Friday, Sept. 20, 1940.

Full details concerning these research prizes can be secured by writing the Electro Manganese Corp., Research Department, 527 Rand Tower, Minneapolis, Minn.

Complex Materials Increase Demands on Chemical Analysis

By Thomas E. Hamill

Washington Chapter—At the February meeting Dr. G. E. F. Lundell of the National Bureau of Standards spoke on "Chemical Analysis of Metallurgical Materials", a subject of utmost importance to the metallurgist.

Dr. Lundell prefaced his talk by sketching pitfalls that surround the chemical analysis of metallurgical materials, such as (1) non-homogeneity of the materials to be sampled, (2) variations in the compositions of different sized particles obtained in machining, (3) changes in the composition of the sample that may occur during storage, (4) volatilization of components during the solution of the sample, and (5) the lack of selectivity of the reactions upon which determinations are based.

It was pointed out that manufactured materials are growing more complex, which not only complicates the immediate analysis, but also necessitates frequent modifications of the methods that are used. Coupled with this is a demand for more complete examinations of materials, and even for determinations of constituents occurring in very minute amounts.

Demands for increased accuracy are also being made, as a result of closer control of manufacturing processes and of more rigid chemical requirements in specifications under which materials are sold.

In chemical analysis high precision does not necessarily insure high accuracy, and it may be difficult to establish the most probable value by analytical work in a given laboratory, or by inspecting results submitted by several laboratories. Any successful treatment of the latter must be preceded by an evaluation of the methods that were used in obtaining the results.

The role of the National Bureau of Standards Standard Analyzed Samples was discussed, and brief accounts of their preparation and standardization were given.

The talk was concluded by brief mention of the applications and probable value of the newer analytical tools, such as potentiometric, photometric, polarographic, spectrochemical, X-ray powder diffraction, microchemical and chemical microscopy methods.

A coffee talk was given by Mr. McHenry of the National Park Service. This Department purchases certain areas of land which contain animals, birds, flowers, forests and rarities of nature, some of which are almost extinct, and converts them into public parks. The talk while not metallurgical in scope was illustrated by colored slides and was intensely interesting.

Wrought Iron Described

By T. W. Kelly

Missouri Mines Group—On March 8, the St. Louis office of A. M. Byers Co. presented a movie on "Wrought Iron" before the Chapter in the school auditorium.

S. A. Musser, Lehigh '35, district representative for Byers, explained the wrought iron process from preparation of the iron in the cupola furnace to the final forming into pipes by the lap and butt welding processes.

Tau Beta Pi (honor engineering fraternity) held its pledging ceremony prior to the movie, at which time 11 juniors were pledged, three of whom were members of the local A.S.M. Group.

Helpful Literature — Mail Coupon Below

Combustion Safeguard

The Flame-otrol, a combustion safety device designed to shut off fuel and prevent explosions in case of flame failure, is described in a 12-page booklet by Wheelco Instruments Co. Bulletin Cd-110.

Air-Gas Proportioning

Proportional mixers for accurate Air-Gas proportioning are described in a catalog made available by the Eclipse Fuel Engineering Co. Bulletin Cd-226.

Mechanite Wheel Chart

A handy wheel chart which contains complete engineering data about all the various types of Mechanite castings available to industry has been prepared by the Mechanite Research Institute of America. It quickly reveals the physical properties of general engineering castings as well as heat, corrosion and wear resisting types. Bulletin Dd-165.

Ramix

Ramix is a prepared magnesite refractory made by Basic Dolomite, Inc. An interesting folder gives full information on its uses in basic open-hearth and basic electric furnaces, and in various non-ferrous furnaces, along with complete instructions for installing. Bulletin Dd-192.

Salt Bath Furnace

"As modern as radio-beam control" says the attractive folder put out by Commerce Pattern Foundry & Machine Co. about the Upton electric salt bath furnace. A brief but informative article on "The Importance of Temperature" by R. C. Upton is included. Bulletin R-208.

Metallizing

Actual photomicrographs illustrate the action of high heat corrosion on a Metallized surface in the bulletin by Metallizing Engineering Co., Inc., describing this new and efficient method of applying a coating of aluminum to iron or steel. Bulletin R-207.

Measuring Metal Coatings

Measurements of local thicknesses of coatings on metals may be made in less than one minute by the Magne-Gage, an interesting instrument described in a 4-page folder by the American Instrument Co. Bulletin Cd-259.

Industrial Furnaces

A series of interesting bulletins showing Dempsey Industrial Furnaces in a wide range of requirements is now available through the Dempsey Industrial Furnace Corp. Bulletin Dd-260.

Chemicals

A complete line of Fluxes, Inhibitors, Zinc, Alkali Cleaners and Acids is described in a new catalog issued by Grasselli Chemicals Dept. of E. I. DuPont de Nemours & Co. Bulletin Dd-95.

Tocco Junior

A new induction hardening machine for hardening small parts is described in a new bulletin released by the Ohio Crankshaft Co. Bulletin Dd-145.

Steel Catalog

Helpful to all designers, engineers and fabricators interested in the use of high tensile, low alloy steel is a new 40-page catalog on Republic Double Strength Steel. Bulletin Dd-8.

Electric Furnaces

A four page bulletin on 36 lb. to 4 lb. high frequency melting furnaces and 3 kw. converter is now available through the Ajax Electrothermic Corp. Bulletin Dd-41.

Shear Knife

A handbook describing the development of the solid steel shear knife by Sam Heppenstall, founder of the Heppenstall Company. Complete, bound in imitation leather, this booklet contains valuable data in the form of a hardness conversion table and shear knife performance charts. Bulletin Dd-122.

Aerocase

A modern method for case hardening and heat treating steel in a liquid bath is provided by the use of Aerocase compounds. Their principal features are described by American Cyanamid and Chemical Corp. in an interesting booklet. Bulletin Oy-148.

The Review

7301 Euclid Ave., Cleveland

Please have sent to me without charge or obligation the following literature. (Circle the numbers that interest you. It is important to write in your company or business connection when you return this coupon.)

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R-207	Dd-122	Ch-283	Cd-126
Cs-259	Oy-148	Ee-263	Cd-126
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Bd-215	Ad-177
Rd-66	Fx-32

Gas-Fired Furnaces

Standard Rated Gas-Fired Furnaces produced by Surface Combustion Co. are included in a new catalog just released by this organization. Bulletin Fc-51.

Rayotubes

Specialized temperature measuring problems to which Rayotube detectors are now being applied are shown in an impressive booklet released by Leeds & Northrup Co. Bulletin Bd-46.

Galvanizing

An informative, historical, simple digest of galvanizing forms a guide to longer life for iron and steel products. This handsome, handy, 24-page book beautifully printed in color is distributed by American Hot Dip Galvanizers Association, Inc. Bulletin Ea-167.

High-Strength Steel Data

Complete mechanical property data on Ductiloy, a new low-alloy, high-strength steel, are given for strip, plate and bars in a folder of Great Lakes Steel Corp. Bulletin Ec-229.

Lectromelt Furnaces

The story behind Lectromelt furnaces is well told in this 48-page booklet issued by the Pittsburgh Lectromelt Furnace Corporation. Tells of development of this type furnace and describes recent improvements. Bulletin Db-18.

Pyrasteel

All types of uses for Pyrasteel, the heat resisting alloy made by Chicago Steel Foundry Co., from astronomical plaques ruled 20,000 lines to the inch to huge kilns, are described in an illustrated pamphlet. Bulletin Ch-184.

Heat Treating Furnaces

A 16-page booklet of Holcroft & Company shows and describes their line of controlled atmosphere heat treating furnaces. Bulletin Ec-203.

Alloy Castings

The "extra point" value of Michiana alloy castings is shown in a booklet released by the Michiana Products Corp. Typical installations are shown. Bulletin Nb-81.

Heroult Furnace

Revised and expanded to include modern major innovations in the construction and operation of the Heroult electric furnace, the latest edition of the American Bridge Co.'s Heroult Electric Furnace Bulletin is available. Bulletin Bb-124.

Insulation

A 32-page catalog containing specific information on all of the sheet, block and pipe insulations developed by the Johns-Manville Company is now available through that company. Bulletin Bb-100.

Hardenized Gearing

Extremely valuable technical information on heat treated hardened gearing, including treatment, control and quenching, comparison of properties, etc., is included in a booklet by the Westinghouse Electric & Mfg. Co. Bulletin Hc-134.

Steel Data Sheets

Wheelock, Lovejoy & Co. gives analyses, physical properties, heat treating instructions, and applications of Hy-Ten, Econom, and S.A.E. alloy steels in concise and easily usable form. Bulletin Ox-74.

Moisture Determination

A very colorful leaflet by the Harry W. Dietert Co. describes new, rapid methods of determining moisture content by drying. Illustrated. Bulletin Cd-198.

Brazing

Economical brazing through the use of EASY-FLO is explained in a booklet released by Handy and Harman. Bulletin Cd-126.

Free Machining Steels

Speed Case and Speed Treat, two steels with increased machining properties, are described in literature available through Monarch Steel Co. Bulletin Cd-255.

Insulating Firebrick

Just off the press—a new booklet gives engineering data on B & W K-16 Insulating Firebrick as manufactured by The Babcock & Wilcox Co. Bulletin Cd-75.

High Speed Steels

Seven grades of high speed steels are thoroughly described in an interesting folder released by Crucible Steel Co. of America. Bulletin Dc-56.

General Data Book

Valuable reference and data are contained in a book by Joseph T. Ryerson & Son, Inc., which gives metallurgical definitions, heat, hardness, and numerical equivalent tables as well as many valuable operating facts. Bulletin Nc-106.

Design

Designing greater sales appeal into products is explained in a colorful 8-page booklet for anyone who contemplates using, or is using Stainless Steel, issued by the Carpenter Steel Co. Bulletin Nc-12.

Portable Potentiometer

An extremely versatile indicating potentiometer with precise balancing, quick standardization, and easy reading scales is described and illustrated in new folder by the Foxboro Co. Bulletin Nc-21.

Heat Treat Chart

Heat treaters everywhere should find a heat treating wall chart complete with S.A.E. specifications a very valuable addition to their shops. Published by Chicago Flexible Shaft Co., manufacturers of Stuart industrial furnaces. Bulletin Ka-49.

Electroplating

E. I. du Pont de Nemours & Co.'s manual on the sodium stannate-acetate electroplating process is particularly timely. Electrodeposition, at first considered useful only for tin coating of recessed and irregularly shaped objects, is now being considered favorably for all types of work. Bulletin Ox-29.

Metal Heating

Improvements in furnace economies, operating conditions and appearance, furnaces that will more satisfactorily meet old requirements or handle new processes, service that will help solve the most stubborn problems are offered and described by Mahr Mfg. Co. in Bulletin Ea-5.

Continuous Heat Treating

Literature on their No. 29-F Heating Machine is now available through the American Gas Furnace Co. Shows picture of machine and gives operating data. Bulletin Be-11.

Furnace Experience

Facts developed through 32 years of engineering and building practically every type of industrial fuel equipment can be obtained through Flinn & Dresein Co. Bulletin Bc-82.

Optical Pyro

No correction charts, accessories, nor upkeep are required with the Pyro optical pyrometer, which is a totally self-contained direct-reading precision instrument made by Pyrometer Instrument Co., and described in Bulletin Ay-37.

Colmonoy

The high resistance to wear and corrosion which distinguishes Colmonoy alloys and overlay metals is explained in a 4-page catalog released by Wall-Colmonoy Corp. Bulletin Bc-85.

Pickling Savings

Savings in the pickling department when Monel is used are shown in an illustrated folder just released by the International Nickel Co. Bulletin Ad-45.

Low-Alloy Steel

A new folder on Mayari R, Bethlehem's high-strength, corrosion resisting steel, is colorfully illustrated with views of its various uses. Bulletin Kc-76.

Thermocouple Insulators

An exceedingly complete stock of thermocouple insulators is described in a bulletin made available by the Claud S. Gordon Co. Bulletin Hc-53.

Mounted Wheel Chart

A convenient ready reference wall chart showing mounted grinding wheels should be of great advantage in the cleaning room, pattern shop, tool and die room, and many other places. It gives at a glance, by means of detailed drawings, actual size, the exact radius of each wheel and its exact shape. Chicago Wheel & Mfg. Co. Bulletin Bd-230.

Oil Burners

North American Mfg. Co. offers a bulletin describing improved low pressure oil burners, one type especially designed for automatic control and ideally suited for use with proportioning control valves. Bulletin Na-138.

Metallographic Reference

Nearly one thousand technical books and reference papers on Optical Principles in Metallurgy are listed in the new Metal Analyst just released by Adolph I. Buehler. Bulletin Lc-135.

Contour Sawing

A virtual text on Contour Sawing, containing over 300 illustrations in its 160 pages, is now available through Continental Machines, Inc. Bulletin Bd-170.

Structural Metal

A complete and concise discussion of magnesium and its alloys is contained in the booklet "Industry's Lightest Structural Metal" which is made available through the Dow Chemical Co. Bulletin Bd-215.

Heat Treating Hints

A helpful, colorful booklet edited by experienced heat treaters is available through the Lindberg Engineering Co. Bulletin Bd-66.

Machinability Chart

A quick and accurate picture of how Rustless stainless steel will respond to your shop operations is given in the "slide-rule" machinability chart, available through the Rustless Iron & Steel Corp. Bulletin Bd-169.

Vacuum Cleaning

A very colorful brochure which illustrates modern cleaning methods by vacuum in industrial plants has been released by The Spencer Turbine Co. Bulletin Dc-70.

Specialized Tester

The Rockwell superficial hardness tester is a specialized instrument for use where the indentation into the work must be kept shallow or of small area, yet sensitivity preserved. A supplement to Wilson Mechanical Instrument Co.'s catalog on the regular Rockwell tester tells all about it. Bulletin Sy-22.

Cr-Ni-Mo Steels

A. Finkl & Sons' catalog is really a technical treatise on chromium-nickel-molybdenum steels for forgings. Pocket size, 104 pages, cloth bound, illustrated by photographs, charts and tables. Bulletin La-23.

High Speed Steel

Required hardness and extraordinary toughness combine to make Firth-Sterling Co. new high speed steel "Mo-Chip" of unusual interest to manufacturers who need a steel that is "practically indestructible." Bulletin Ad-177.

Ni-Cr Castings

Compositions, properties, and uses of the high nickel-chromium castings made by The Electro Alloys Co. for heat, corrosion and abrasion resistance concisely stated in a handy illustrated booklet. Bulletin Fx-32.

A REAL BARGAIN!

New Book Available at 40% discount to members until July 1st

The popular symposium on Precipitation Hardening which was presented at the Chicago Metal Congress last fall is now available in a handsome 450 page book having been written by 19 leading experts in the field of Age Hardening and Precipitation Hardening. You will want to add this book to your library.

Content: Theory of Age Hardening—Role of Strain in Precipitation—Aging in Iron & Steel—Dispersion Hardening Alloys—Age Hardening Precious Metal Alloys—Age Hardening Copper Alloys—Precipitation Hardening in the Heavy Alloys.

Until July 1st this worthwhile book will be available to members for only \$3.00 per copy. After that time the price will be \$5.00 per copy. Send in your check or money order today and save two dollars!

450 pages . . . 196 illustrations . . . 6 x 9 . . . red cloth binding . . . \$3.00

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address

AMERICAN SOCIETY FOR METALS
7301 Euclid Avenue
Cleveland, Ohio

April, 1940

HERE AND THERE WITH A.S.M.

MEMBERS

THE NEW England Metallurgical Corp., of which A. DUDLEY BACH is president, has purchased the Greenman Steel Treating Co. of Worcester, and will continue to operate this plant as a Worcester branch.

The Worcester division will be in charge of LLOYD G. FIELD, who was formerly superintendent of the heat treating department of the Trimont Mfg. Co. L. G. GREENMAN, formerly president of the Greenman Steel Treating Co., is retiring from active service and his duties will be taken over by Mr. Bach.

To HARTFORD goes the genial chairman of the Boston Chapter, and expert photographer for Chapter meetings, ARDEN L. KNIGHT. Formerly New England sales manager for Wheelock, Loveloy & Co. of Cambridge, Mass., he has now joined the sales force of the Hartford office of the Latrobe Electric Steel Co.

All of his friends in the Boston Chapter extend their best wishes for his success in his new field of activity.

Now known as Fieser-Lundt, Inc., the former Ensign-Reynolds Co. has been purchased from American Radiator & Standard Sanitary Corp. by F. J. FIESER and Mr. LUNDT. They will continue in the manufacture and engineering of all gas industrial equipment.

NOTED recipient of one of the Modern Pioneers Awards of the National Association of Manufacturers is FREDERICK G. HUGHES, general manager of New Departure Division of General Motors Corp., Bristol, Conn., and past president of the A.S.M.

The scroll of achievement was presented to Mr. Hughes by Governor Raymond E. Baldwin at a dinner at the Hartford Club on Feb. 16.

The specific citation came as a result of his patents on pre-loaded ball bearings, which enabled machine builders to gain extreme accuracy and rigidity in shaft and spindles. This is only one of many accomplishments of Mr. Hughes in the realm of invention and manufacture.

Mr. Hughes was graduated from Yale University in 1900 and was a member of Sigma Xi. Previous to coming to New Departure in April 1911, he was experimental engineer at the Bethlehem Steel Co. and chief engineer at the Driggs-Seabury Corp.



F. G. Hughes

W. A. OLSEN, formerly with SKF Steels, Inc., is now with Uddeholm Co. of America, Inc., New York, as manager in charge of tool steel.

TRAVELING on the west coast during most of last month, E. H. DIX, Jr. visited various aircraft companies and addressed more than 600 engineers in the Southern California district, presenting an illustrated discussion of the theory and practice of heat treating aluminum alloys.

WANTED
Used, modern, carbon arc furnace, either Heraut or Electromelt type, for industrial melting.

Address Box 4-1
American Society for Metals
7301 Euclid Ave. Cleveland, Ohio



J. J. Crowe

The Fourth Biennial Pennsylvania Inter-Chapter Meeting Will Be Held at State College, Pa., May 3 and 4. These are the men who will make the meeting a success. Top Row: James P. Gill, president A.S.M.; H. J. French and F. B. Foley, meeting chairmen; C. L. Clark and J. J. Kanter, speakers. Second Row: Walther Mathesius, dinner speaker; E. C. Bain and C. H. Herty, meeting chairmen; M. A. Grossmann and W. E. Jominy, speakers. Bottom Row: C. W. Heppenstall, who will provide the entertainment program; V. N. Krivobok, N. L. Moehl, G. V. Luerssen, and Howard Scott, discussion leaders. The complete program of the meeting was published in the March issue of THE REVIEW.

New York Finishes First Half of Brilliant Season Featuring Varied Subjects

By Harold M. Malm

With the February meeting, the New York Chapter closed the first half of its season.

Off to a good start in October, with a rousing well-crowded dinner-smoker the following (considerably saner) meetings were addressed by luminaries of various professions—journalism, research metallurgy, tool manufacturing metallurgy, and automotive research.

The November meeting was held in conjunction with the celebration of the 75th anniversary of the founding of Columbia School of Mines. The speaker of the evening was S. Paul Johnston, editor of *Aviation*, who gave a very revealing talk on aviation development and the importance of aircraft production in wartime.

On Dec. 11, Peter Payson, research metallurgist of the Crucible Steel Co. of America, gave a most interesting and unusual talk on the effect of alloy additions on high alloy steels.

Mr. Payson viewed alloy additions not just as so many per cent of this or that, but rather as the cause of a certain change in the S curve (or TTT transformation-temperature-time curve as he called it). The effect of alloy additions on the S curve is the clue to their effect on properties of steels.

He considered the effect of increasing additions of various elements, following in detail the addition of chromium from 5% up to about 30%.

A further discussion of the austenitic nickel or manganese steels and the various tungsten and molybdenum tool and die steels concluded the talk.

A. H. D'Arcambal, the popular, humorous, chief metallurgist of the Pratt & Whitney Co., Hartford, Conn., spoke at the January meeting on "Ma-

chinability". Mr. D'Arcambal described some of the problems encountered both in manufacturing and using fine tools.

The February meeting was addressed by W. Paul Eddy of the General Motors Truck Co. Research Laboratories. Mr. Eddy devoted the entire evening to discussion and pictures of field failures in automotive service.

The effects of different fuels, lubricants, manufacturing technique, alloys, design and operation were described to

a deeply interested group. This talk was unique in that it dealt with the investigation of actual failures and the remedies prescribed.

Corrosion Resistance and Joining of Parts Important Aircraft Problems Says Moore

By G. G. Wilcox

Hartford Chapter held a regular meeting on March 12 at the City Club. The after-dinner feature was a movie, "The American Way", presented by American Airlines, Inc., presenting the advantages and pleasures of air travel.

The technical session was addressed by R. R. Moore of the Naval Aircraft Factory at Philadelphia, on "Metallurgy of Materials Used in Aircraft Construction".

With the increasing emphasis on lightness and durability, the old type of wood and fabric construction has given way to metals. This is true not only of airplanes, but is becoming increasingly important in railway, automotive, and marine construction.

Two important problems in the use of light alloys are corrosion resistance and joining of parts.

The corrosion problem is attacked in two ways—by the use of alloys corrosion resistant in themselves, and by the use of coatings. The usual trouble with the first method is lack of strength.

A coating of pure aluminum on a strong base metal may be used. This produces a soft skin, makes joining difficult, and is subject to easy wear by abrasion. Anodic coating and painting

JOHN J. CROWE, manager of apparatus research and development department of Air Reduction Co. in Jersey City, became on April 1 assistant to Herman Van Fleet, vice-president and operating manager. Mr. Crowe will henceforth be located in New York City.

Mr. Crowe's first position was with the Bureau of Standards, where he was, among other things, largely responsible for the growth of the Pyrometry Division. In 1915 he accepted a position with the Navy Department and, as physical metallurgist, assisted in the establishment of metallurgical laboratories in several of the Navy Yards.

At the Philadelphia Navy Yard he had his first real contact with the practical application of oxy-acetylene welding, and in 1924 he joined Air Reduction Co.

During his entire career Mr. Crowe has been active in A.S.M. In 1920 and in 1923 he served as chairman of the Philadelphia Chapter, in 1921 as a director of the Society, and in 1932 as chairman of the New York Chapter. He is currently on the METAL PROGRESS Editorial Advisory Committee.

For ten years a director of the American Welding Society, he served as its president in 1935.

F. D. STEINWAY, research metallurgist, A. O. Smith Corp., died Saturday, March 30. "Don" will be missed in Milwaukee, where he took an active part in Chapter activities. He was a past chairman of the Program Committee, and had just been nominated to the Executive Committee.

are other methods of protection for the light alloys.

For struts and braces S.A.E. 4130 tubing is in general use, since it welds easily and has a high strength of 90,000 psi. Stream-lined tie-wires of 18-8 stainless are used with 2 to 3% molybdenum to prevent pit corrosion. These wires show some tendency to creep, which may be partly overcome by a heat treatment at 400° F.

Motors use a great variety of alloys, about one-half the weight in light alloys, and half in steels. It is interesting to note that in 1922 the weight per horsepower was 2½ lb., in 1936 1.4 lb., and at present about 1.1 lb.

The value of impact and fatigue testing was stressed, as was the importance of quality and the small safety factor usually allowed, which justifies the great stress placed on inspection.

The reason for the smooth, high finish specified on so many surfaces is the prevention of fatigue failures. It has been found that even a rough machined surface may reduce the endurance limit by as much as 50%.

Magnaflex testing is assuming greater and greater importance as an inspection tool, both for new parts and routine inspection of parts in service.

Nickel-Molybdenum And Chrome Steels Popular for Gears

By Charles A. Nagler

Northwest Chapter—The gear industry in reality started with the automotive industry, said E. F. Davis, chief metallurgist, Warner Gear Division, Borg-Warner Corp., Muncie, Ind., when he discussed "Gears" at the March meeting.

The first automotive gears were made on the milling machine and were

hand-indexed. In 1905 the first attempts were made to improve the physical properties of the gear by heat treatment.

The early alloy gear steels were imported from Europe, where the German Krupp Co. introduced them in 1867.

Chromium-vanadium steels were very popular at first. A carburized 3.5 to 5% nickel steel was then used until the motor car industry started the use of a nickel-molybdenum steel with higher carbon than the present S.A.E. 4620.

In 1924 this alloy was adopted by the Timken Roller Bearing Co. In 1930 fine-grained steels were introduced. The nickel-molybdenum steels are of the direct quenching variety and give a quiet running gear.

Among the oil hardening types of steel the chromium steels enjoyed great popularity in 1922. At about this time the Leeds and Northrup Hump furnace was introduced and used for hardening the chromium steel gears.

However, they were found to pit and wear out after hardening in oil, so they were reheated and hardened after the Hump furnace quench into a cyanide bath. This was found to increase the life of the gears by four times.

Cyaniding is not very economical, and a certain health hazard exists, so attempts were made to find another method of hardening gears. Propane gas was introduced into the hump furnace, and this was the beginning of the continuous hardening of gears.

Cold Finishing Movie Shown

Mahoning Valley Chapter—At the February meeting A. E. Crockett of Jones & Laughlin Steel Corp. presented a very interesting and instructive movie entitled "Cold Finished Steel".

Simultaneous with the showing of the movie, Mr. Crockett gave a very interesting and informative lecture relative to the various processes involved in the cold finishing of steel.

Help Wanted

Address answers care of A. S. M., 7301 Euclid Ave., Cleveland, unless otherwise stated.

TWO OR THREE MEN who have had some experience in the sheet and strip rolling of brass, steel or other metals. Should be 25 to 30 years old and connected with production of sheet metals for two or three years. Box 4-5.

METALLURGIST: Recent graduate with several years steel mill experience. Box 4-10.

TOOL AND DIE ENGINEER: For the design and development of punches and dies used in the production of small, intricate parts. Technical education desirable but not absolutely essential. Should have at least ten years experience. Age 35 to 45. Salary \$400. Box 4-15.

SALES REPRESENTATIVE: For manufacturer of chemicals and heat treatment materials. Eastern territory. Can use representative handling other lines if not competitive. Box 4-20.

ASSOCIATE METALLURGISTS: Government positions in ferrous, non-ferrous and ore dressing. Open competitive examinations will be held by the United States Civil Service Commission. Application forms may be obtained from the secretary of the Board of U.S. Civil Service Examiners at any first-class post office, or from the United States Civil Service Commission in Washington, D. C., and should be filed not later than May 13.

METALLURGIST: To work on research and general problems. Preference given to man under 35 having advanced training and experience on alloy steels. Should be capable of handling small research department. In reply state age, training, experience, nationality, religion, references, salary expected, whether married, and any other pertinent information. Box 4-25.

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Improvements in Oxy-Acetylene Torches Facilitate Machining, Hardening, Softening

By Walter M. Saunders, Jr.

Rhode Island Chapter—"Flame Machining, Flame Hardening, Flame Softening" was the title of the talk given at the Feb. 7th meeting by John J. Crowe, assistant to vice-president and operating manager, Air Reduction Sales Co.

According to Mr. Crowe, the first oxy-acetylene torches were introduced into this country about 1905, being the outcome of original experiments of LeChatelier in France on flame temperature measurements.

Marked improvements since then in design of the torches were interestingly described with slides, and the chemical reactions between oxygen and acetylene were used as a basis for showing what happens when iron is cut by flame.

Flame cutting of intricate shapes as compared to machining operations illustrated one of the advantages which have caused its widespread adoption.

Other applications briefly mentioned were cutting threads, removing large risers from steel castings, and billet gouging or descaling. Instead of laborious grinding or chipping, surface defects on billets are quickly and completely removed by the torch.

Three classes of flame hardening are spot hardening, where the work is stationary; progressive hardening, with the torch traveling along the object; and spinning hardening, applied to circular pieces. Combinations of the last two methods are possible.

In direct contrast, Mr. Crowe mentioned flame softening, a practice which also has many applications.

Design of equipment to carry out

cutting and hardening does not appear complicated in any respect, and allows many variations depending on the individual and the job to be done. A short moving picture illustrated many applications of flame hardening, particularly the hardening of ways on east iron machine tools.

Russia came into the spotlight at the dinner preceding the meeting. E. J. Lowry, Woonsocket Color & Chemical Co., known to foundrymen all over the country, and until a short time ago, an American engineer for about eight years with the Soviet, talked entertainingly on his observations and experiences there.

Ernst Talk Draws High Praise When Given at York

By A. Floyd Whalen

York Chapter—When Hans Ernst arose to present his story of the "Physics Of Machinability" at Waynesboro, Pa., on March 20, the ballroom of the Anthony Wayne Hotel was filled to capacity with some 200 persons.

THE REVIEW has carried this story before, but we feel like taking a quotation from Holy Writ and saying "The half had never been told". The beautiful colors of his moving pictures, and the clear detail of his slides, brought forth admiration from all present.

John Shank and his committee deserve a world of praise for preparing this fine program, which included a chicken dinner and a supply of the famous southern Pennsylvania apples which were presented to all as they left for points north and east.

List of A.S.M. Employment Offices

Members of the American Society for Metals who are interested in securing a new position or firms who have a position open should communicate immediately with the nearest employment office. These offices are all members of the Employment Councilors Association of the U. S., whose Cleveland member, the Technical Placement Service, is national employment headquarters for the Society. These employment offices are maintained to benefit the firm members as well as individual members of the Society, and companies having an opening will find that these offices carry a select list of well-qualified A.S.M. technical men.

AKRON, OHIO
Merrill D. Wright
Central Vocational Bureau
203 Buckeye Bldg.

ATLANTA, GEORGIA
A. H. Benton
Personnel Service Co.
Mortgage Guarantee Bldg.

BALTIMORE, MARYLAND
H. C. Clodf
Personnel Service Co.
1065 Lexington Bldg.

BUFFALO, NEW YORK
E. F. Dean
Dean Employment Service
Brisbane Bldg.

CHICAGO, ILLINOIS
Bert L. Parsons
Consolidated Agencies, Inc.
209 South State Street

CINCINNATI, OHIO
E. A. Cost
Progressive Placement Service
300 Schmidt Bldg.

CLEVELAND, OHIO
T. G. Frotheroe
A. R. Bradley
Technical Placement Service
504 Swetland Bldg.

COLUMBUS, OHIO
Harry C. Vaughn
Harry C. Vaughn & Associates
36th Floor, A.L.U. Bldg.

DALLAS, TEXAS
E. M. & Claude Karr
Karr Employment Service
Republic Bank Bldg.

DAYTON, OHIO
Allen G. Banks
Banks-Mitchell Employment
Service
304 Keith Bldg.

DENVER, COLORADO
B. L. Johnson
Business Men's Clearing House
Midland Savings Bldg.

DETROIT, MICHIGAN
George M. Miller
George M. Miller Employment
Service
National Bank Bldg.

HARTFORD, CONNECTICUT
Emory L. Wolfe
Personnel Service Bureau, Inc.
720 Main Street

HOUSTON, TEXAS
Rodney Quimby
Quimby Employment Service
308 Bankers Mortgage Bldg.

INDIANAPOLIS, INDIANA
Ancil T. Brown
Brown Efficiency Bureau
806 Guaranty Bldg.

KANSAS CITY, MISSOURI
T. DeWitt Hughes
Western Employment Counselors Assn., Inc.
707 Sharp Bldg.

LOS ANGELES, CALIFORNIA
Fred M. Smith
Pacific Audit & System Co., Inc.
711 Story Bldg.

MEMPHIS, TENNESSEE
Shapiro Positions Exchange
Union Planter's Bank Bldg.

MILWAUKEE, WISCONSIN
R. J. Willette
National Clerical Bureau
6069 Plankinton Bldg.

MINNEAPOLIS, MINNESOTA
W. A. Gilman
James Ells Service
929 Plymouth Bldg.

NASHVILLE, TENNESSEE
Murray E. Hill
Murray E. Hill & Associates
Third National Bank Bldg.

NEW ORLEANS, LOUISIANA
O. P. West
Commercial Employment
Agency
713 Canal Bank Bldg.

NEW YORK, NEW YORK
Albert H. Rohrer
Acorn Employment Service, Inc.
63 Park Row

OAKLAND, CALIFORNIA
Harry B. Smith
Pacific Audit & System Co., Inc.
1419 Broadway

OMAHA, NEBRASKA
Harry H. Knapp
Western Reference & Bond
Assn.
834 Redick Tower

PEORIA, ILLINOIS
Harold S. Taes
Taes Employment Agency
405 Main Street

PHILADELPHIA, PA.
J. D. Stephens
Business Service Co.
1600 Walnut Street

PITTSBURGH, PA.
E. C. Coby
Coby Service Bureau
Bessemer Bldg.

SAN ANTONIO, TEXAS
George T. Ferris
George T. Ferris Service
210 Gunter Office Bldg.

SAN FRANCISCO, CALIF.
Harry B. Smith
Pacific Audit & System Co., Inc.
57 Post Street

SPOKANE, WASH.
J. I. Kinman
Kinman Employment Service
110 Howard St.

ST. LOUIS, MISSOURI
E. T. Hasselbring
Business Service Co.
16th Floor, Chemical Bldg.

SYRACUSE, NEW YORK
R. E. Taylor
Taylor Employment
333 South Warren St.

TOLEDO, OHIO
E. Sieffke
Toledo Personal Service Co.
1125 Edison Bldg.

WASHINGTON, D. C.
A. C. Wright
Boyd Employment Service
1333 F. Street, N. W.

CHAPTER CALENDAR

CHAPTER	DATE	PLACE	SPEAKER	SUBJECT
Baltimore	May 20	Engineers Club	Emil Gathmann	Ingot Surfaces—Their Relation to Sound Steel
Boston	May 3	United Shoe Machinery Corp., Beverly, Mass.	A. P. Lee	Cast Iron
Buffalo	May 9	Hotel Buffalo		Annual Meeting
Chicago	May 9	Towers Club	S. M. Norwood	Stainless Steel—Selection, Applications and Fabrication
Cincinnati	May 2	Hotel Alms	Zay Jeffries	Annual Meeting
Cleveland	May 6	Cleveland Club	J. P. Gill	Tool Steels
Dayton	May 8	Middletown, Ohio	R. F. Mehl	Recrystallization
Detroit	May 13	Fort Shelby Hotel	J. R. Vilella	Metallographic Structures
Hartford	May 17	Hotel Bond	M. J. R. Morris John F. Wyzaek	New England Regional Meeting
Indianapolis	May 20	Hotel Washington		Round Table Discussion
Los Angeles	May 9	Scully's Cafe	H. H. Smith	High Tensile Corrosion Resistant Nickel-Copper Steels
Milwaukee	May 21	Milwaukee Athletic Club	A. H. Wilson	Platinum (Annual Party)
New Haven	May 16	Hammond Laboratory, Yale University	J. P. Gill	Tool Steel
New Jersey	May 20	Essex House, Newark	N. E. Woldman	Aircraft Metallurgy
New York	May 13	Bldg. Trade Employers Assoc. Clubrooms		Modern Trend of Materials in Railroad Transportation Design
North West	May 15	Minnesota Union, Univ. of Minn.		Annual Meeting
Notre Dame	May 8	Engineering Audit, Univ. of Notre Dame	Gilbert E. Doan	Metallurgy of Welding Processes
Ontario	May 3	Toronto	H. Thomasson	Controlled Spot Welding
Oregon	May 10		R. Knoblauch	Pyrometry
Penn State	May 3 and 4	State College, Pa.		Fourth Biennial Pennsylvania Inter-Chapter Meeting
Peoria	May 13	Caterpillar Tractor Co.	E. P. Kerrush	Quality Control Obtained by Modern Inspection Equipment
Pittsburgh	May 9	Roosevelt Hotel	Gordon T. Williams	Heat Treatment of Steels
Puget Sound	May 8	Engineers Club	R. Knoblauch	Pyrometry
Rochester	May 2	Todd Union, Univ. of Rochester		Past Chairmen's Night
Rockford	May 22	Food Shop	J. P. Gill	Tool Steels
Rocky Mountain	May 18	Steel Works "Y", Pueblo, Colo.	Geo. M. Klrk	Elements of Industrial Stability
Saginaw Val. Group	May 21	Bancroft Hotel, Saginaw, Mich.		Iron Powder Metallurgy and Tool Steel
Southern Tier	May 20	Cornell University, Ithaca, N. Y.	J. P. Gill	Modern High Speed Steels
Springfield	May 20	Hotel Worthy		Annual Meeting
St. Louis	May 17	York Hotel	A. K. Seemann	Surface Treatment by the Oxy-Acetylene Flame
Toledo Group	May 27	Hillcrest Hotel	R. P. Koehring	Powder Metallurgy
Tri-City	May 14	Rock Island Arsenal Auditorium	Anson Hayes	Some Properties of Sheet Steel Products
Washington	May 13	Dodge Hotel	J. P. Gill	Modern High Speed Steels
Worcester	May 15	Svea-Gille Clubhouse	John H. Hitchcock	Annual Meeting
York	May 17			Annual Meeting

April, 1940

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